RECENT WARM-WEATHER TRENDS AS SHOWN BY GRAPHS OF ACCUMULATED TEMPERATURE

By W. A. MATTICE

[Weather Bureau, Washington, D. C. May 23, 1930]

Has the country been experiencing a series of abnormally warm years? We hear many suggestions concerning this, among them the ones from the "old-timers" who continually say that the weather isn't like it was when they were young. Here in Washington, for instance, we continually hear that skating formerly lasted from December to March—on the Potomac River too! Also, not so long ago, there was a cartoon in a local paper showing a freight train being run over the ice! It is a common experience of Weather Bureau officials at nearly every station that people are continually talking about the "good old days" when snow lay on the ground much longer than it does now, or skating lasted longer, or the winters are mild compared with those "when we were young," and the summers are also becoming either warmer or cooler, etc. These are common observations throughout the country, and at present there is much comment that the past few years have been abnormally warm, especially the winters.

This interest in the matter of possible recent abnormal trends in seasonal weather prompted a study of the temperature conditions for the past 10 years in comparison with the normal, by seasons, and for several representative sections of the country.

Instrumental measurements of the weather by trained observers are naturally highly accurate, compared with our personal reaction to small changes in temperature, pressure, humidity, etc. For example, we may experience weather which feels abnormally cool when the daily mean temperatures are very close to normal. This is not uncommon, for our reaction to the weather depends not only on our physical condition at the time, but also on our impression of what the weather should be. Our mental hazards are as real in connection with the weather as they are on the golf links.

There are several ways of comparing temperatures in one place with those in another. We can use departures from normals for various periods, the extremes, extreme range, etc., but for our present purpose it seems best to use the accumulated departures from normal of weekly mean temperatures. This method of comparison is preferable because it affords a very graphic picture of what has really happened. We can remember easily long spells of hot weather in spring or summer, or protracted severe weather in winter, and the accumulated departure method of charting abnormalities presents these in their true proportion. These accumulated experiences are deeply impressed on our minds just as their imprint stands out on the graph of accumulated departures. Again, a long period of moderately warm or cold weather usually makes only a fleeting personal impression; but small deviations from normal, when long sustained, are of much importance and they show up also in proper proportion on the accumulated departure graph.

For a country as large as the United States any small number of stations would hardly be representative of general weather conditions; in fact, the some 200 first-order Weather Bureau stations are considered inadequate in some respects. However, we selected for this study six stations disposed in a fairly straight line across the country and representing weather types for rather typical sections, as follows: Washington to represent the Atlantic type; Cincinnati, the Ohio Valley type; Kansas City, the Plains type; Denver, the Rocky Mountain type; Salt Lake City, the Great Basin type; and Sacramento, the Great Valley of California type. These stations all lie close to the fortieth parallel and represent typical

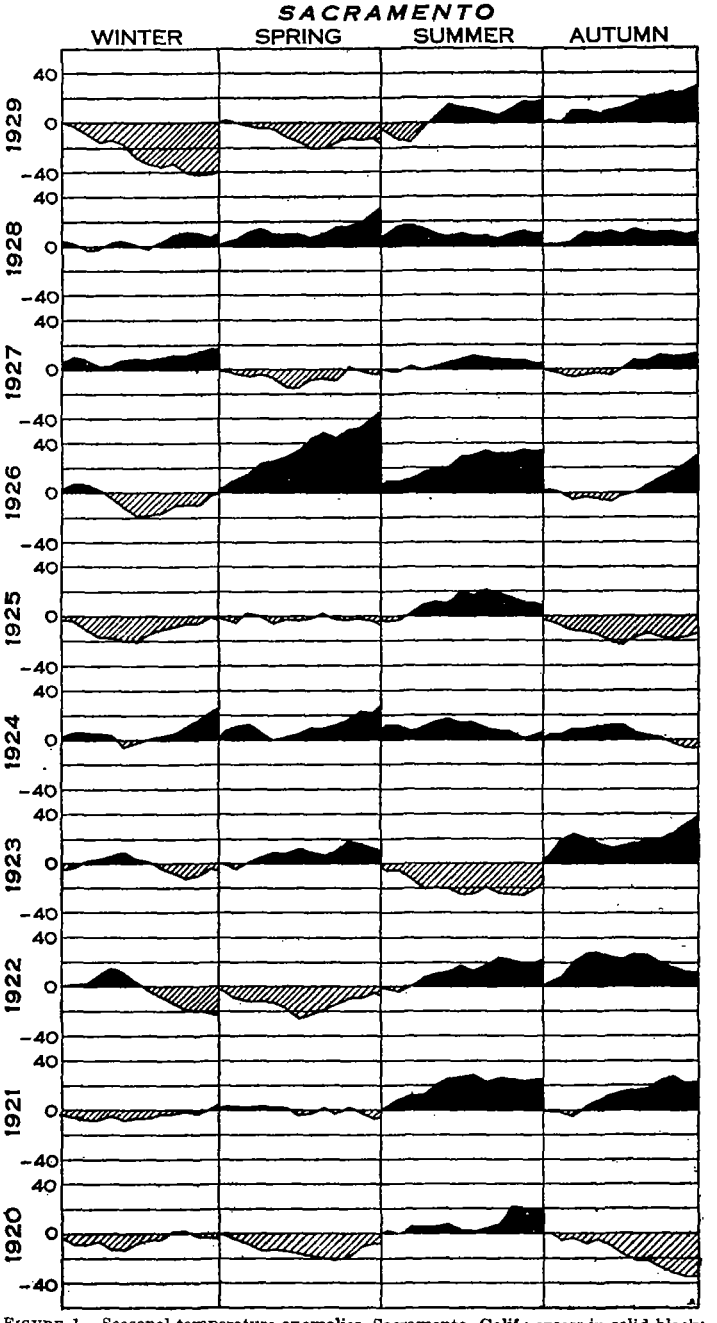

FIGURE 1.—Seasonal temperature anomalies, Sacramento, Calif.; excess in solid black; deficit in hatching

areas that are geographically comparable, but are not, of course, representative of weather conditions for the entire country.

The graphs are based on departures from normal of the weekly mean temperatures, as published in the Weekly Weather and Crop Bulletin. The graphs represent

accumulated values from week to week from the beginning of the respective seasons; that is, beginning with the first week, its departure is entered and the succeeding weeks' departures are added algebraically. Each season is entered separately, the yearly period of 52 weeks being arbitrarily divided into seasons of 13 weeks each. Thus, the winter season covers the approximate period from December 1 to February 28. There is, of course, some

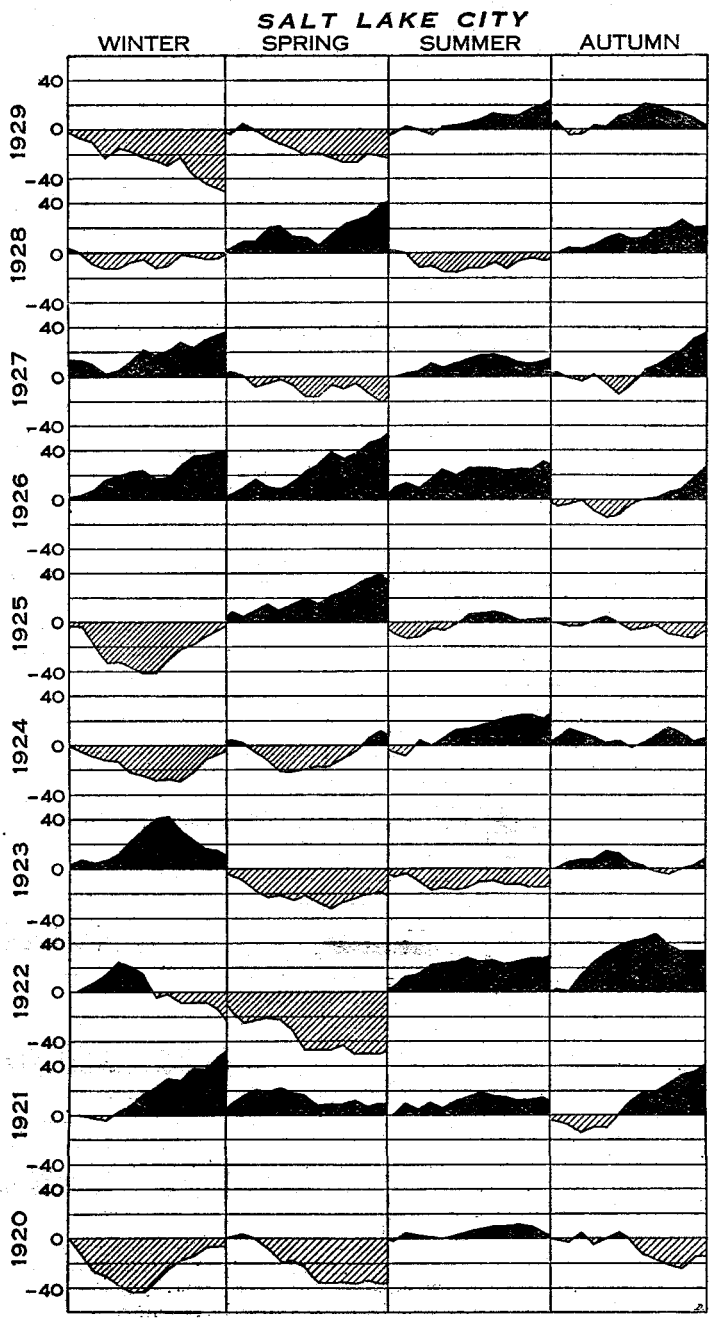

FIGURE 2.—Seasonal temperature anomalies, Salt Lake City, Utah; Excess in solid black; deficit in hatching

overlapping and some end days lost, but, in general, the seasons are strictly comparable.

Reference to the Washington graph shows that 8 of the past 10 winters were warm, 1 was cool, and 1 nearly normal. For the spring, 8 were warm, and 2 cool; the summers were evenly divided, 5 being warm and 5 cool. The autumns were nearly all warm, 9 being above normal, with only 1 below. Thus, we can say, as far as Washington is representative of the Atlantic coast, that the past 10 years have been warm, especially the winters and autumns. In the aggregate there are 40 seasons shown on this graph, 4 for each of the 10 years; of these 30 have been warm, 9 cool, and 1 about normal.

At Cincinnati conditions as to warmth were not so marked as at Washington. Here 6 winters were warm and 3 cool, with 1 normal; the springs were evenly divided, as were the summers. The autumns were divided 7

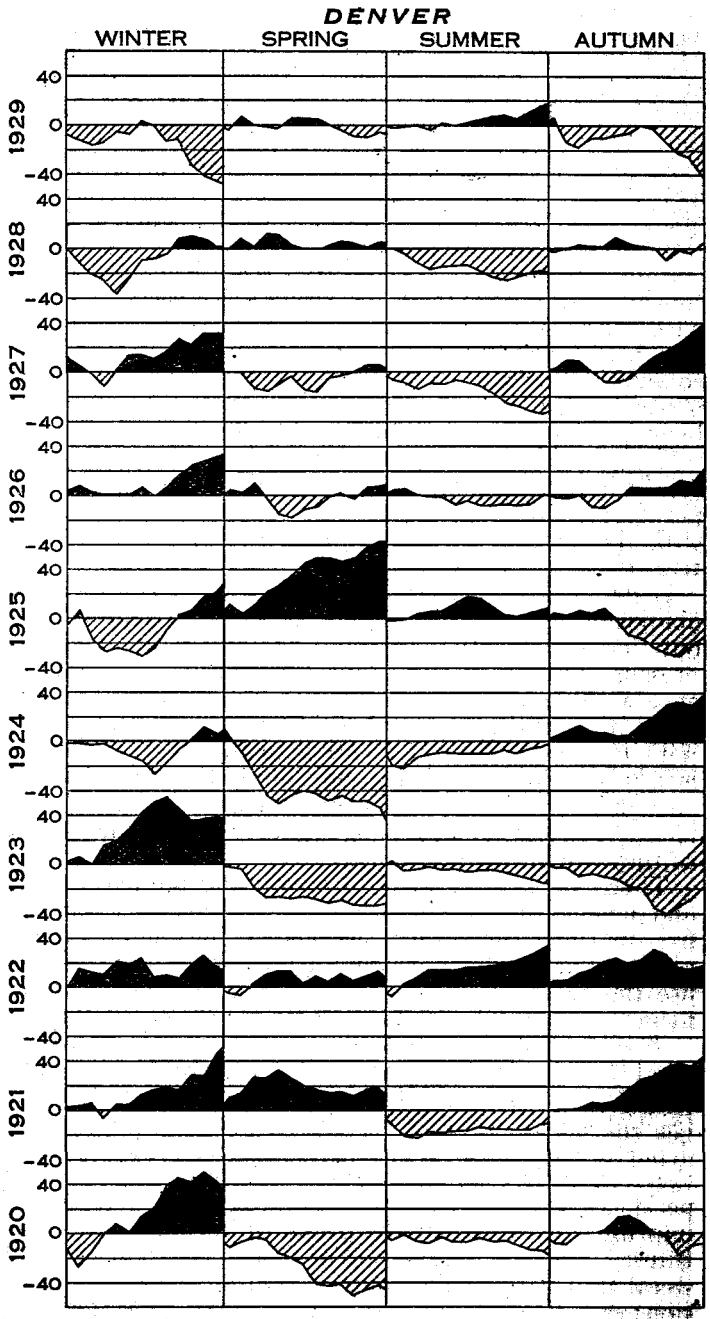

FIGURE 3.—Seasonal temperature anomalies, Denver, Colo.; excess in solid black deficit in hatching

warm and 3 cool, and a summary of the totals shows 23 seasons warm, 16 cool, and 1 normal.

At Kansas City 6 winters were warm and 4 cool; 6 springs were warm and 4 cool; 4 summers were warm and 6 cool, while 6 autumns were warm, 2 cool, and 2 normal. In the aggregate 22 seasons were warm, 16 cool, and 2 normal.

At Denver 6 winters were warm and 4 cool; 4 springs were warm and 6 cool; 3 summers were warm and 7 cool;

6 autumns were warm and 3 cool, with 1 normal. Thus, at Denver, there were 19 seasons warm, 20 cool, and 1 normal, making the totals nearly equal for the period.

At Salt Lake City the winters were evenly divided; 4 springs were warm and 6 cool; 7 summers were warm and 2 cool, with 1 normal, while 7 autumns were warm, 2 cool, and 1 normal. Here the totals swing back toward the tendency in the east, with 23 seasons warm, 15 cool, and 2 normal.

At Sacramento 3 winters were warm, 6 cool, and 1 normal; 4 springs were warm, 5 cool, and 1 normal; 9 summers were warm, 1 cool; 8 autumns were warm and 2 cool. Thus, at Sacramento the summers and autumns have been consistently warm and the winters and springs relatively cool. The totals show 24 seasons warm, 14 cool, and 2 normal.

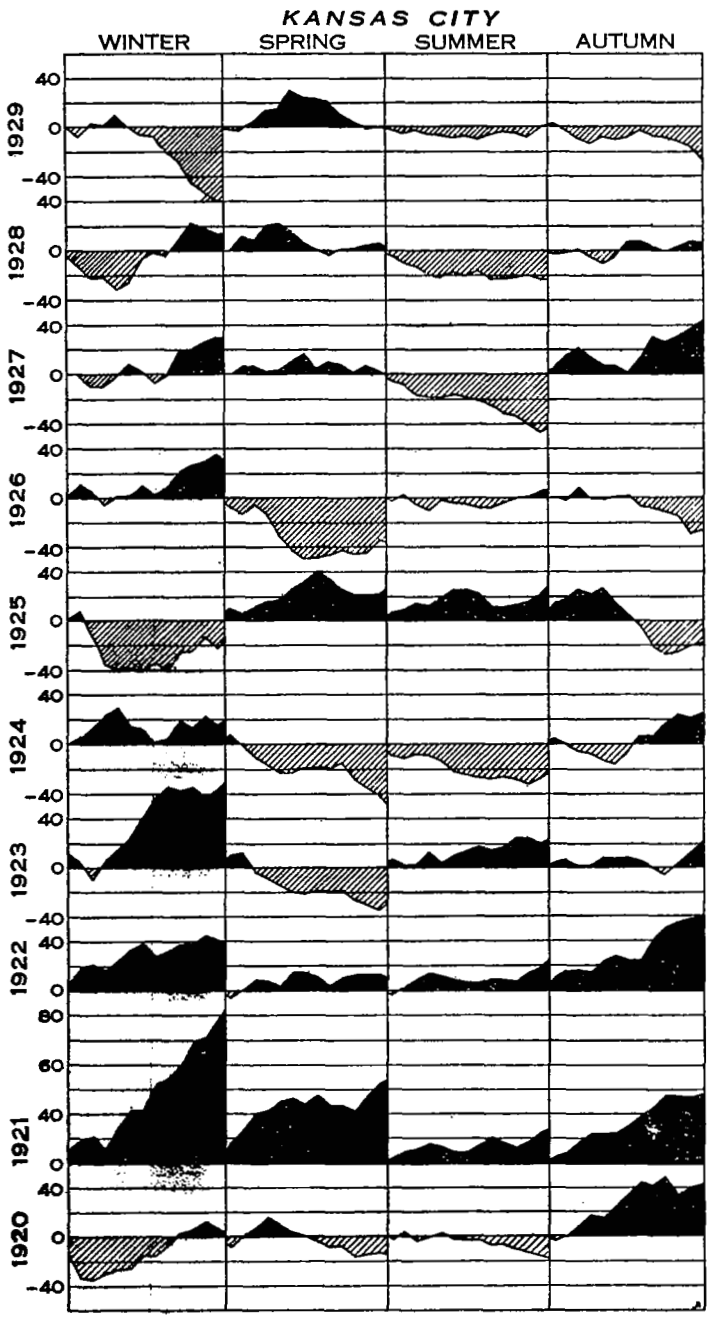

FIGURE 4.—Seasonal temperature anomalies, Kansas City, Mo.; excess in solid black; deficit in hatching

Grouping the graphs and taking the combined number of stations and seasons, 240 in all, there were 141 seasons warm, 90 cool, and 9 with about normal temperatures. Thus, considering the entire country as represented by these areas, the past 10 years have been decidedly warmer than normal. Considered by seasons, we find 34 winters warm, 23 cool, and 3 normal; 31 springs were warm, 28 cool, and 1 normal; 33 summers were warm, 26 cool, and 1 normal; and 43 falls were warm, 13 cool, and 4 normal.

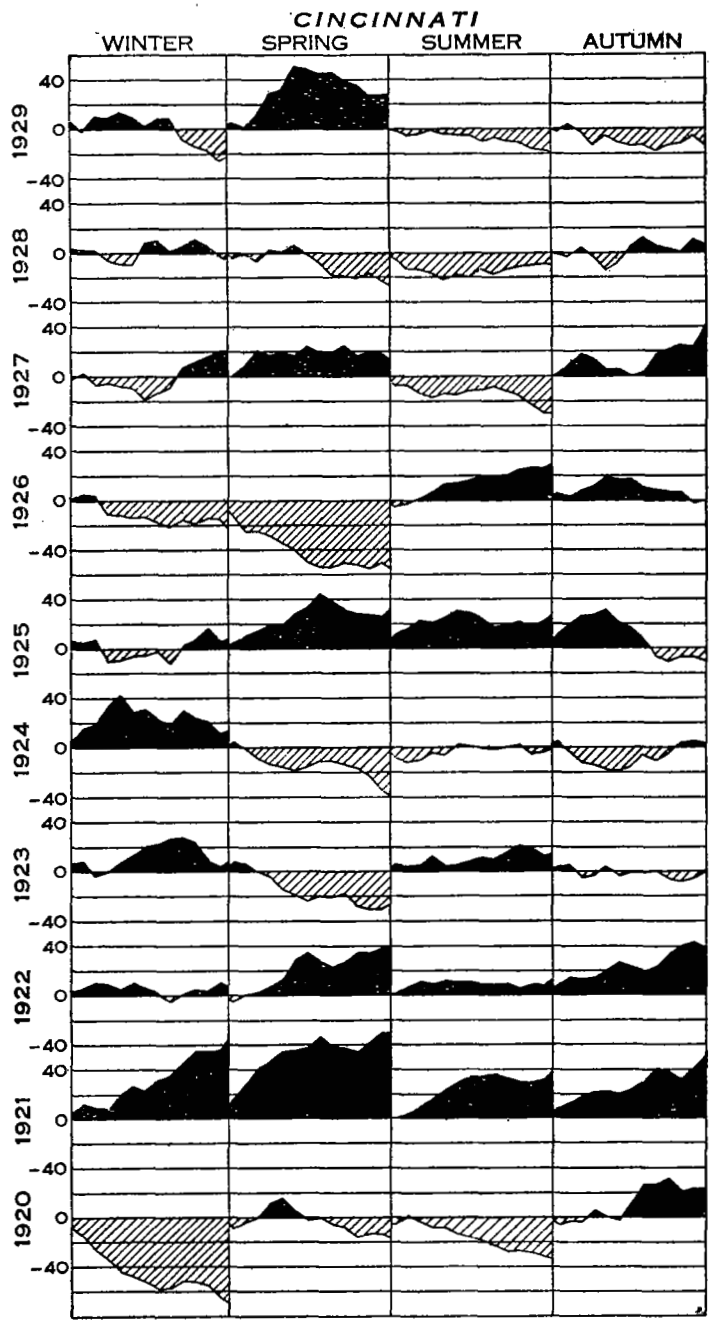

FIGURE 5.—Seasonal temperature anomalies, Cincinnati, Ohio; excess in solid black; deficit in hatching

Summarizing more generally we find that during the last 10 years the winters in the eastern half of the United States have been warm, with 7 above normal, 1 below, and 2 average. In the western half they were evenly divided. The springs were slightly warmer in the east, 6 being warm and 4 cool, while conditions were just

reversed in the west. Four summers were warm and 6 cool in the east, while in the west 8 were warm and 2 cool. The autumns were equally and markedly warm in both sections, each showing 8 warm and 2 cool.

If we consider the individual years we find that in 1920 the winter, spring, and summer were cool, but the autumn warm. In 1921 all seasons were warm, especially the autumn when all sections had above normal temperatures. In 1922 all seasons were warm, especially the summer and autumn, with all sections above normal. In 1923 the winter was warm, the spring cool, the summer evenly divided between east and west, and the autumn warm. In 1924 the winter was warm, the spring cool, the summer cool, and the autumn warm. In 1925 the winter was cool and the spring and summer warm, while the autumn was slightly cool. In 1926 the winter was warm, the spring cool, the summer evenly divided, while the autumn was warm. In 1927 the winter was warm, the spring evenly divided, the summer cool, and the autumn warm, with all sections above normal. In 1928 the winter was evenly divided, the spring was warm, the summer was cool, while the autumn was warm. In 1929 the winter was cool, the spring evenly divided the summer warm, and the autumn evenly divided.

There are some features of the individual graphs that invite attention. The Washington graph shows two years of abnormally high temperatures in winter and spring, 1921 and 1929, the accumulated departures for 1921 being especially marked when at one time there was an accumulation of about 150°. The Cincinnati graph also shows this abnormal condition in the two years, but 1929 is not so marked as in the Washington graph. The winter of 1921 in Kansas City is especially noteworthy, as the accumulation at the end of the winter was over 120° above

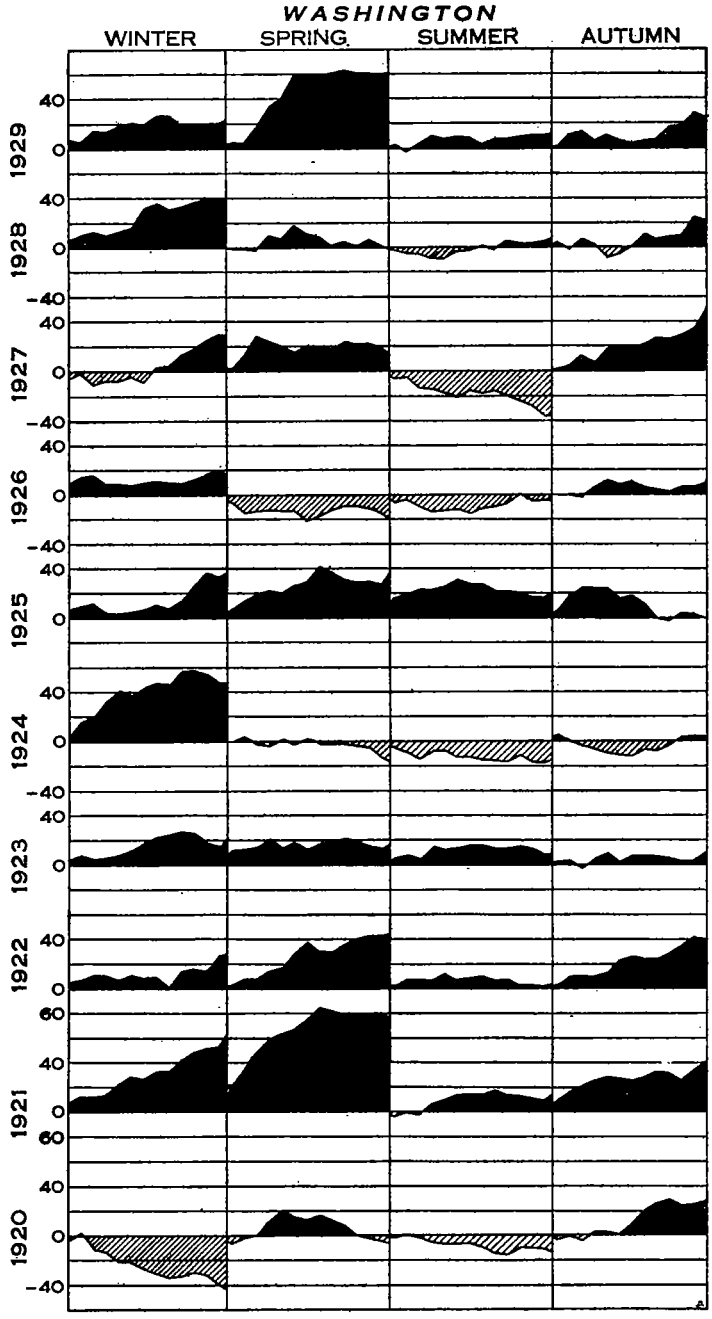

FIGURE 6.—Seasonal temperature anomalies, Washington, D. C.; excess in solid black; deficit in hatching

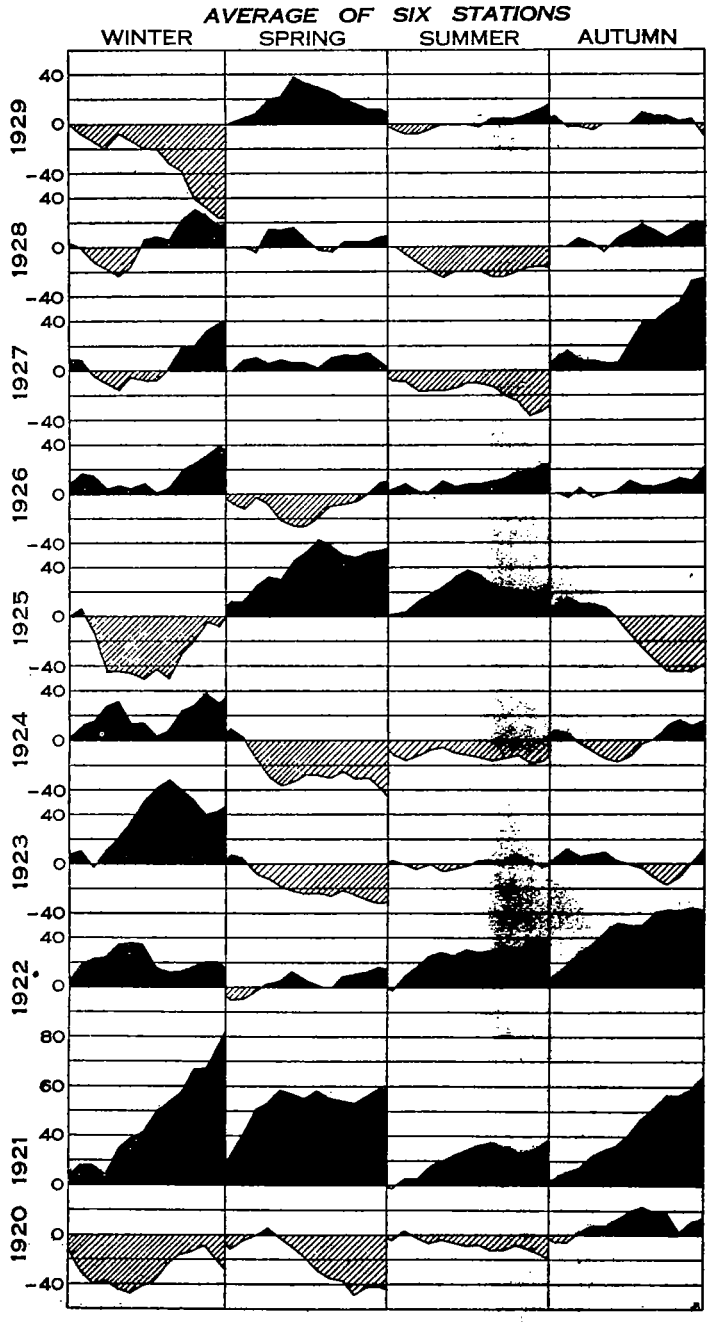

FIGURE 7.—Average of the six stations for years 1920–1929.

average, while the combined winter and spring accumulations reach over 180°. The graphs for the other stations, however, present no such marked accumulations.

The composite graph for all stations shows several interesting features. It will be noted that the range of temperatures on this graph has been increased to twice that on the others in order to give greater detail. The year 1921 immediately stands out as abnormally warm, with large positive accumulations for all seasons. No other year of the series shows such mild weather, while 1920 indicates that it was a generally cool year, except for the autumn.

A general survey of the composite graph indicates that the past 10 years have been mild, on the whole, except 1920, and, with the exception of 1929 and 1925, the winters have also been rather mild. Springs also show a tendency toward mildness, while summers apparently are close to normal. Autumns are also mild, especially 1921, 1922, and 1927. It would seem, therefore, that the claim that the past 10 years have been rather mild is substantiated by the evidence presented.

This paper was prepared at the suggestion of Mr. J. B. Kincer and the author is indebted to him for helpful suggestions and criticisms. Acknowledgment is also made of the valuable aid rendered by Mr. H. D. Wilson in preparing the graphs.

THE COOPERATIVE OBSERVER[1]

By CLARENCE J. ROOT

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The contribution of the United States Government to the climatological service of the world consists of more than 200 first-order weather stations, with their trained personnel, and nearly 5,000 cooperative observers. The cooperative stations have been established in nearly all parts of the country, and even extended into Alaska, Hawaii, and Porto Rico. The reports from these stations are in great demand. They are used by attorneys in legal proceedings, by those seeking new locations on account of business or health, by engineers in irrigation, reclamation, water supply, sewerage, drainage, and construction projects, by meteorologists, and others in the study of climates, by agriculturists and manufacturers, the latter in locating and operating plants, by shippers, railroads, and insurance companies in settling loss and damage claims, and locally by the public through the newspapers or by inquiry from the observer.

I can not say too much in praise of these public-spirited citizens who serve as cooperative observers. With some the weather is a hobby, others are interested in science, but with many it is the desire to contribute, and they carry on day after day, month after month, and year after year. Many of these observers are leaders in their communities; the others are serious-minded citizens, doing their bit for town and country, and it must be remembered that all have their vocations by which they are furnished a livelihood, and that Weather Bureau work is a secondary consideration. There are few organizations that secure so many men and women who render such high-class service without remuneration.

The writer has been engaged in climatological work over a period of 24 years and has known many cooperative observers. All of this experience has been in connection with the Illinois section and the remarks that follow must necessarily pertain to the service in Illinois.

When the climatological service was reorganized in its present form in 1895 the Illinois section was placed under Prof. Willis L. Moore at Chicago, with Charles E. Linney as assistant director, but in a few months Mr. Linney was made director. Prior to 1895 the work had been handled at Springfield by Col. Charles F. Mills, a State official, and John Craig, Government observer. In 1899 Mr. Linney brought the service back to Springfield and in 1900 he was succeeded by Montello E. Blystone. William G. Burns relieved Mr. Blystone January 1, 1903, and Mr. Burns turned the work over to the present section director in 1911.

In discussing personnel mention should be made of some of the old-time observers. The oldest continuous original record on file at the Illinois Section center is that begun by the late Dr. J. O. Harris and continued by his daughter, Emily H. Merwin, of Ottawa, Ill.

Dr. J. O. Harris was born in New York State in 1828. He served in the Civil War as assistant surgeon of the Fifty-third Illinois Infantry. His labors in the meteorological field date back to 1853, when he acted as correspondent for the Smithsonian Institution. Doctor Harris was a voluntary observer from 1870 until his death at Ottawa in 1905, when his daughter succeeded him.

Friedrich Brendel, M. D., came to this country from Bavaria in 1850 and settled in Peoria in 1852. His records of temperature and rainfall began in December, 1855, and continued practically unbroken for 50 years, the official connection with the Weather Bureau ceasing with the establishment of the regular station at Peoria in 1905. Doctor Brendel was a physician of excellent standing, a botanist of note, author of a 90-page pamphlet entitled "Flora Peoriana," a man of scientific tastes, and of deep devotion to his work. It is related of him on the best of authority that in his later years, while seriously ill and lying apparently unconscious, he would still rouse regularly about the observation hour and direct the nurses to read the thermometers. Doctor Brendel's death occurred August 10, 1912, at the advanced age of nearly 93 years.

The most remarkable substation record in Illinois is that of John West James in Riley Township near Marengo. Mr. James moved to Illinois from New York in 1860, beginning his work as voluntary observer for the Smithsonian Institution in that year and continuing almost without interruption until his last illness in 1917, thus completing a gratuitous service of 57 years. This is the longest record by any cooperative observer in the State, and probably one of the longest in the United States. The entire record was made on the same farm, so far as the writer knows without change of location, and during the entire 57 years not a single month was missing. Mr. James was a student of astronomy and meteorology, and his weather reports were considered practically infallible. It is recalled that when the writer first met him in 1911 he confessed that he had missed a few days back in the seventies and he wished to know if that was very bad. He was a single man, living with relatives who were inclined to ridicule his interest in science but he continued the work nevertheless until called by death.

Whittaker Holden came from England. He began keeping the weather records at Aurora, Ill. in 1879, and continued until his death in 1913, a period of 34 years. He had collected an interesting group of aneroid barometers, and on one of his trips had brought back from Eng-

[1] Presented before American Meteorological Society, Des Moines, Iowa, Dec. 28, 1929.